ABSTRACT

A negative resistance field-effect element that is a negative differential resistance field-effect element capable of achieving negative resistance at a low power supply voltage (low drain voltage) and also enabling securement of a high PVCR is formed on its InP substrate 11 having an asymmetrical V-groove whose surface on one side is a (100) plane and surface on the other side is a (011) plane with an InAlAs barrier layer (12) that has a trench (TR) one of whose opposed lateral faces is a (111) A plane and the other of which is a (331) B plane. An InGaAs quantum wire (13) that has a relatively narrow energy band gap is formed at the trench bottom surface as a high-mobility channel. An InAlAs modulation-doped layer (20) having a relatively wide energy band gap is formed on the quantum wire as a low-mobility channel. A source electrode (42) and a drain electrode (43) each in electrical continuity with the quantum wire (13) constituting the high-mobility channel through a contact layer (30) and extending in the longitudinal direction of the quantum wire (13) as spaced from each other, and a gate electrode (41) provided between the source electrode (42) and the drain electrode (43) to face the low-mobility channel (20) through an insulating layer or a Schottky junction, are provided. Owing to the foregoing configuration, a very narrow-width quantum wire whose lateral confinement size can, without restriction by the lithographic technology limit, be made 100 nm or less is usable as a high-mobility channel, whereby there can be obtained a negative resistance field-effect element that develops a negative characteristic at a low power supply voltage and enables securement of a high PVCR.